Columbia (MO) Sanitary Landfill Bioreactor & Related Projects

KS WORKS!
3-23-11

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Chris Snider, Burns & McDonnell

Columbia, Missouri

- 2010 Census ~ 108,500
  - 5th largest city in state
- 1320 FTE, 5th largest employer in the city
- "Full Service City"

  Airport, Bus/PedNet, Solid Waste, Streets & Stormwater, Sewer, Water & Light, Parks & Rec, Fleet Ops, Volunteer Services

Public Works Department
Solid Waste Division

- State of the Art Waste Management System
  - Only Bioreactor Landfill in Missouri, one of only a few publicly-owned Bioreactors in the U.S.
  - 2.1 MW LFGTE Plant
  - Material Recovery Facility
  - Compost Operation & Two Remote Mulch Sites
  - Residential & Commercial Trash & Recycling Collection
  - Waste Minimization Program

Landfill Details

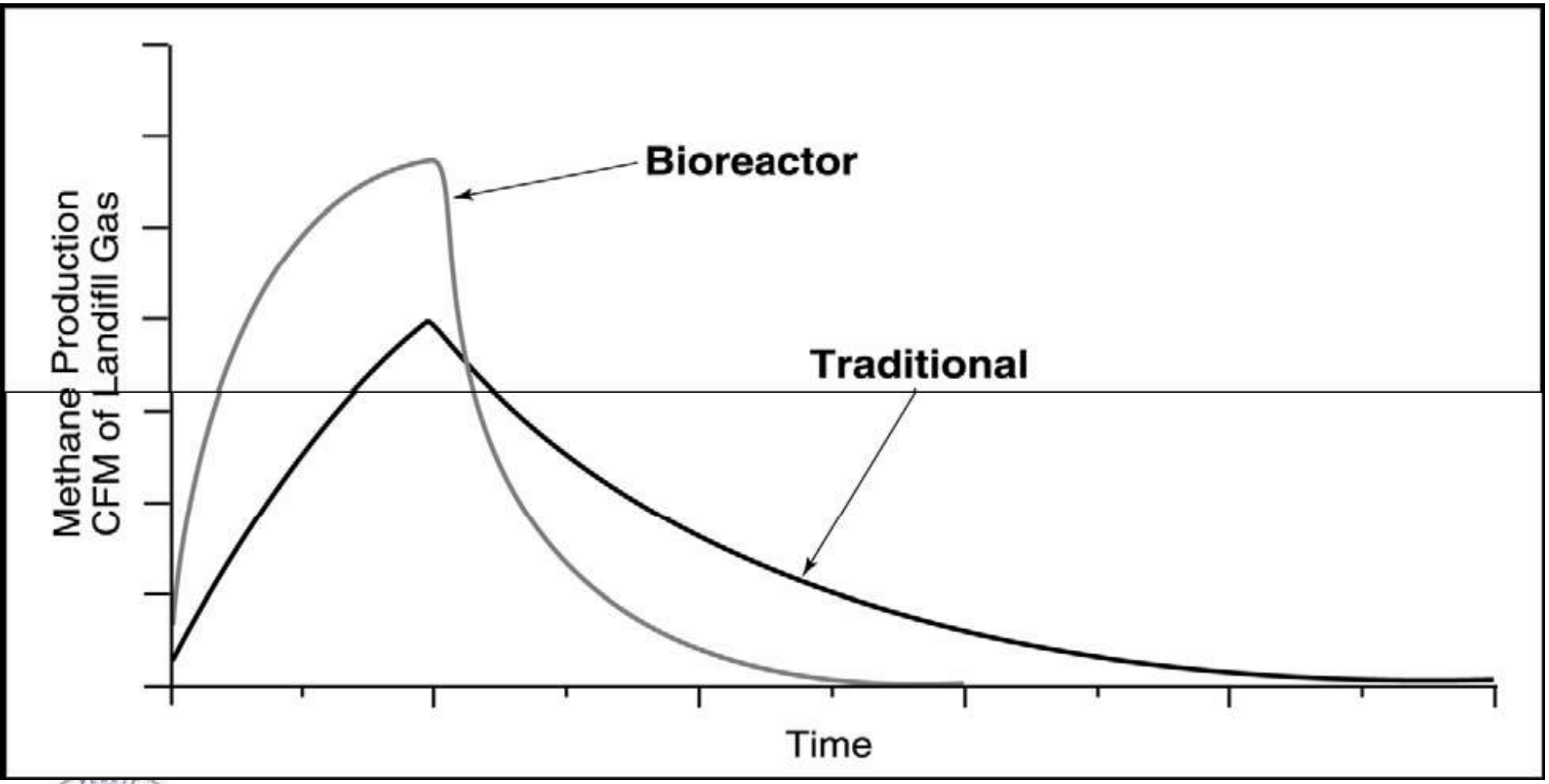
- Filling Operations Started in March 1986
- 720 acre site
- 107 Acres Permitted for Sanitary Landfill
- Average 169,000 Tons Annually
- 3,140,000 Tons in Place
- 6,009,949 Tons Total Capacity
- $3.9 Million FY11 Budget, 15.25 FTE


CITY OF COLUMBIA
Welcome to Missouri's first
WATER & LIGHT
BIOREACTOR LANDFILL
permitted April 21, 2009
designed by Camp, Dresser & McKee
LANDFILL · GAS TO ENERGY PLANT · MATERIAL RECOVERY FACILITY · COMPOSTING FACILITY
Sustainability in Motion

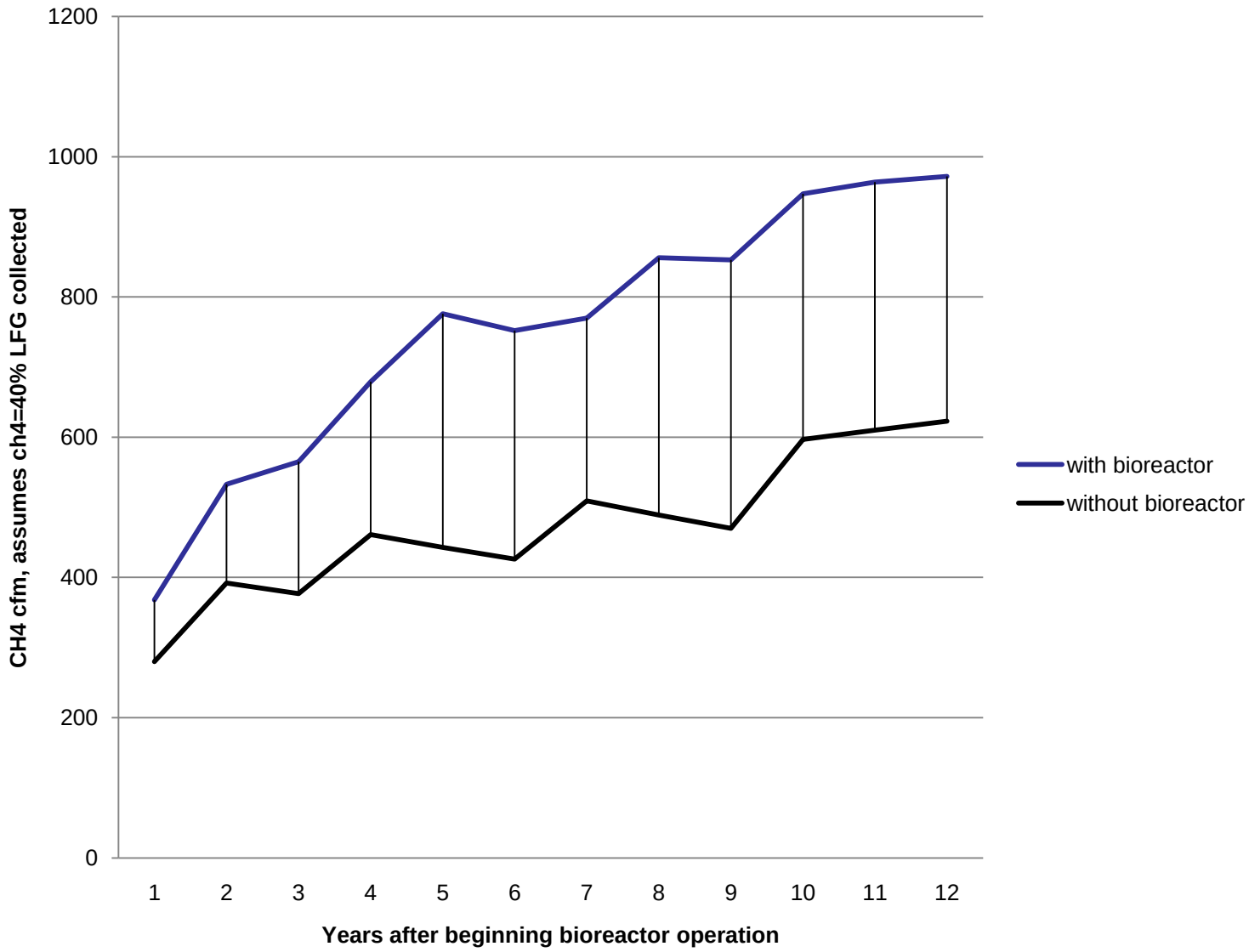
Basic Bioreactor Technology

- Add water to the material to accelerate decomposition and biological stabilization of waste (40% moisture content=bioreactor)
- Increases landfill gas generation rate
- Due to settling, additional space is gained
- Lower waste toxicity → Lower Risk!
- Reduced post-closure costs

Bioreactor - Accelerated Gas Generation

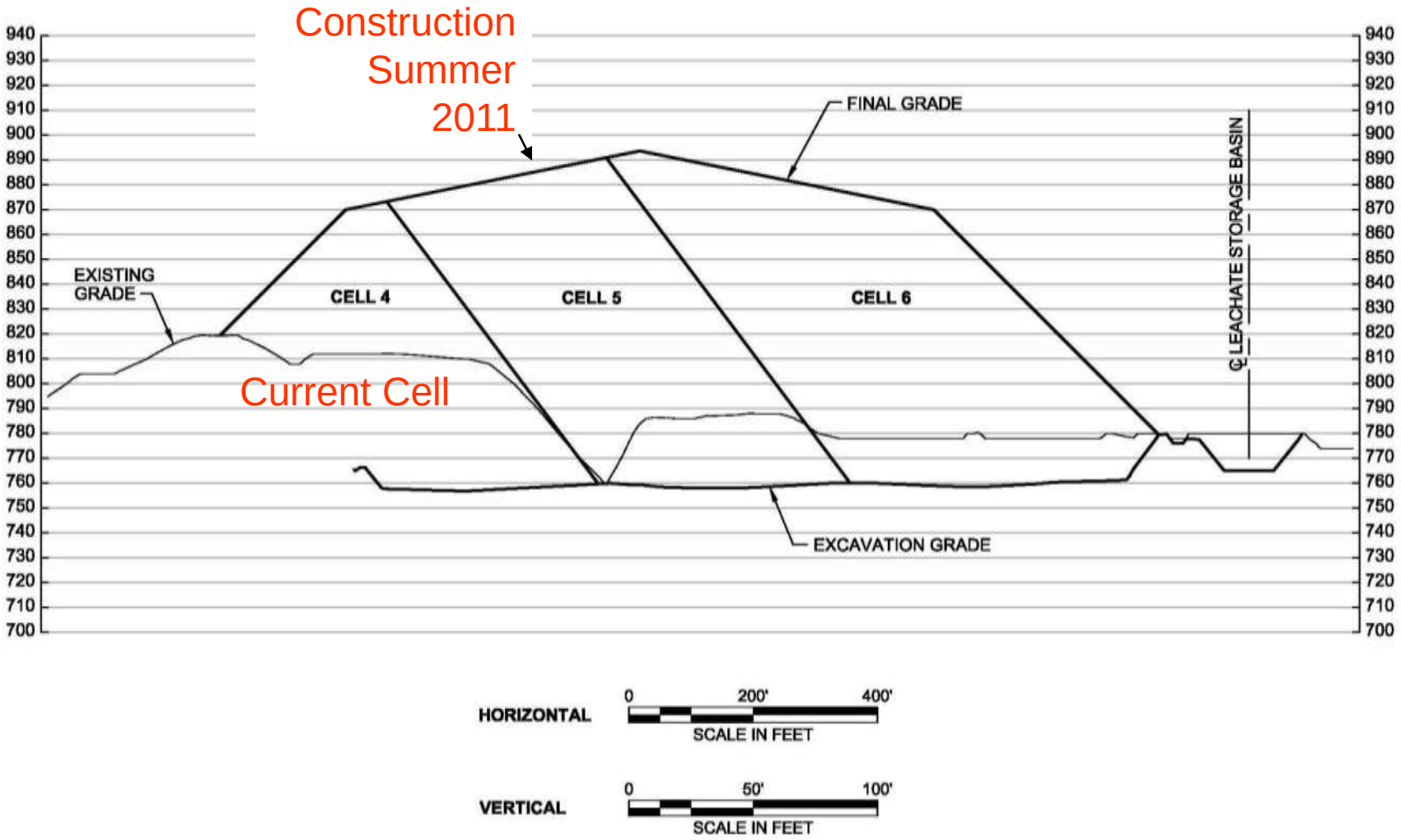


Projected Columbia Methane Collection Bioreactor Consideration (2005 study)




PERMITTED WASTE BOUNDARY
PROPERTY LINE
CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
CELL 6
PRE-SUBTITLE D SOLID WASTE DISPOSAL AREA
LEACHATE STORAGE BASINS
BIOGAS ENERGY PLANT

Cross-Section Bioreactor Cells



Cell 4 Liner

Synthetic Liner - 9.4 acres

Enhanced Leachate Collection and Drainage Media

Enhanced Leachate Collection and Drainage Media

Conductivity Testing

$48,000 – located 13 damaged locations

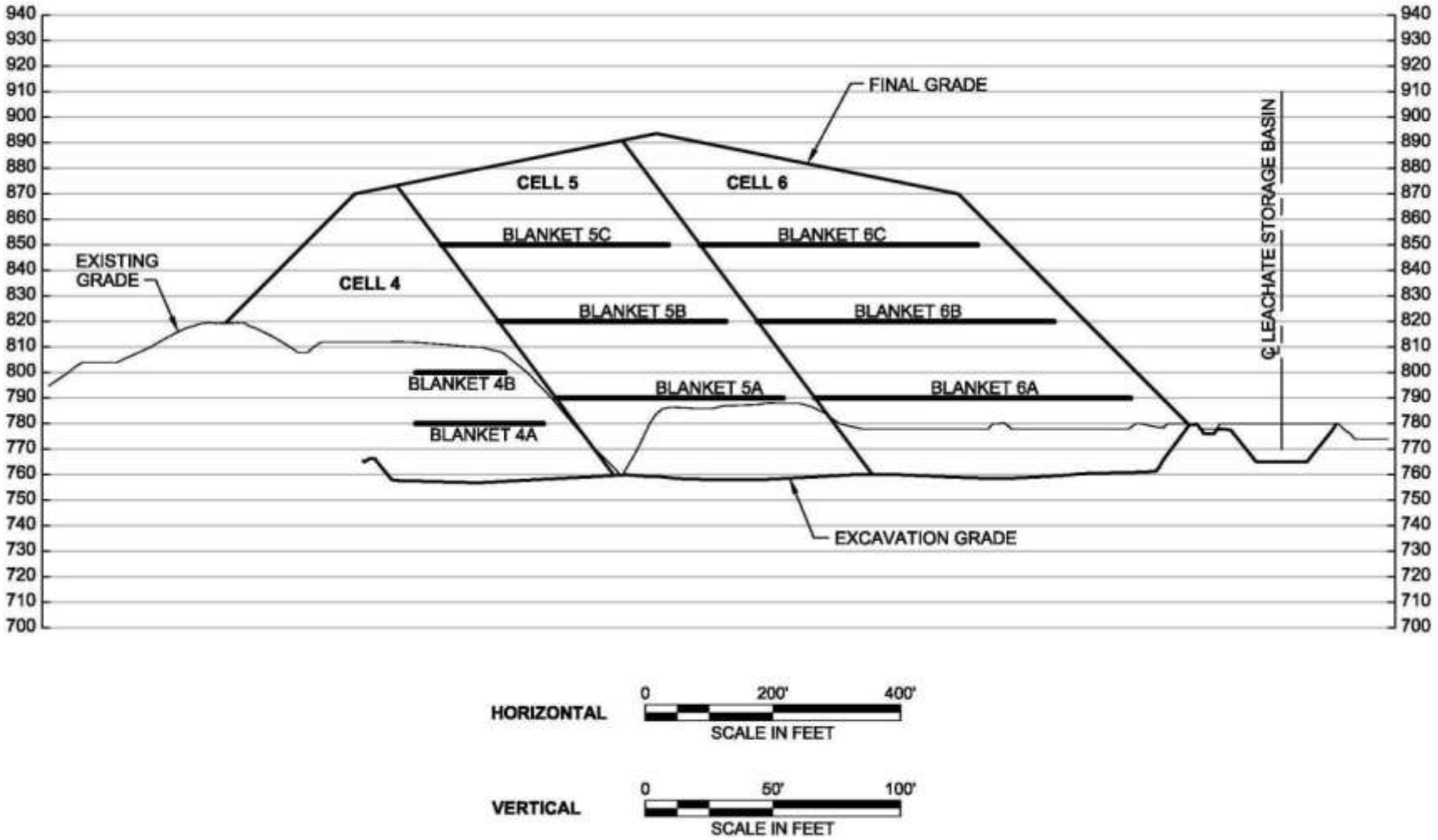
Damage to Liner During Installation

Drainage Blanket

- Challenge: How do you get 36,000 gallons of water per day, evenly distributed through out the waste mass?

- Combination of surface application and subsurface drainage blankets.

Drainage Blankets



Rolling Out the Blankets

Drainage Blanket Installation

Blanket and Gas/Water Line

Alternate Daily Cover

- Approved for a variety of daily cover materials
  - Sprays, glass, tires, mulch, tarp, etc.
- Key: allow rain and liquid added to flow throughout the waste mass
- Current Permit Modification Request for Mulch as Intermediate Cover

Mulch for Cover

Feed Water Storage

Leachate Pond

Progress of Bioreactor

- Constructed Cell as Bioreactor in 2008, began accepting waste
- Received Bioreactor Operation permit April 21, 2009
  - Began putting city-collected yard waste in landfill
- Constructed Force Main to deliver liquids
- Siphon Design underway to deliver surface water
- Temp Sensors installed in waste at blanket elevations to detect liquid migration

CHALLENGE #1 – SUMMER 2010 –
SENSORS INOPERABLE

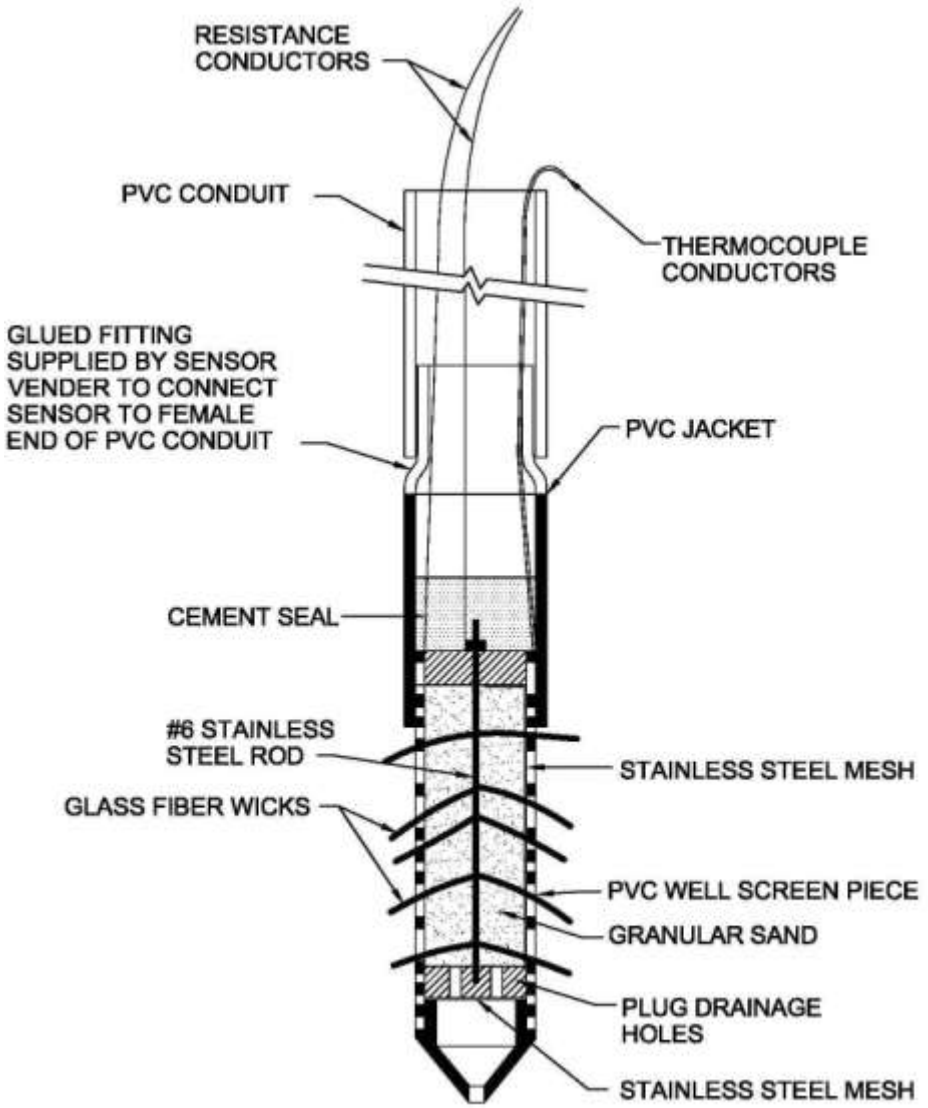
CHALLENGE #1

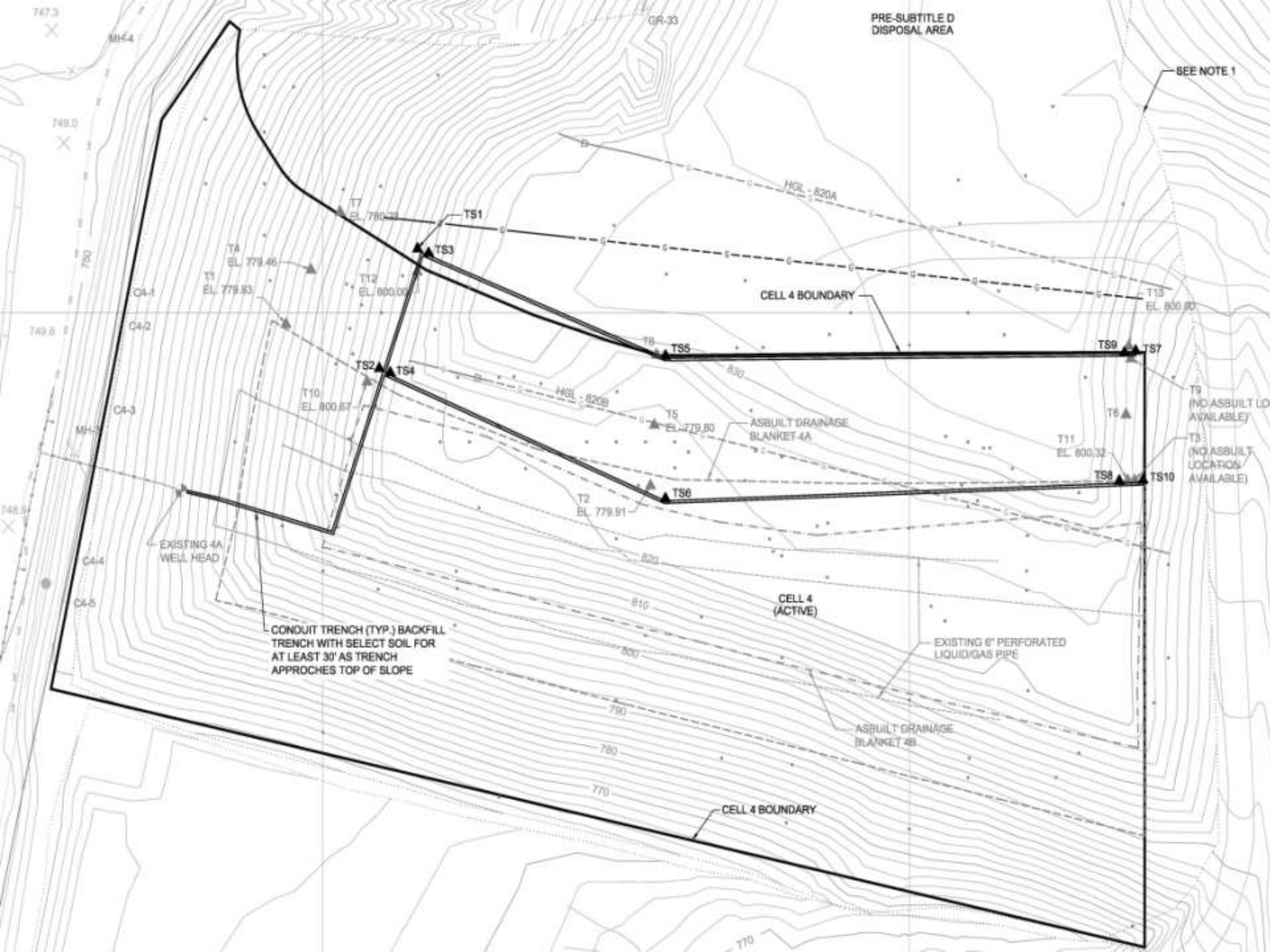
- 13 Original Temp. Sensors Installed Horizontally as Waste was Placed
- Summer/fall 2010 Design Vertical Installation of New Sensors
- DNR Approval
- 10 Replacement Sensors Scheduled for Installation Summer 2011

  (temperature & moisture)

Moisture & Temperature Sensor

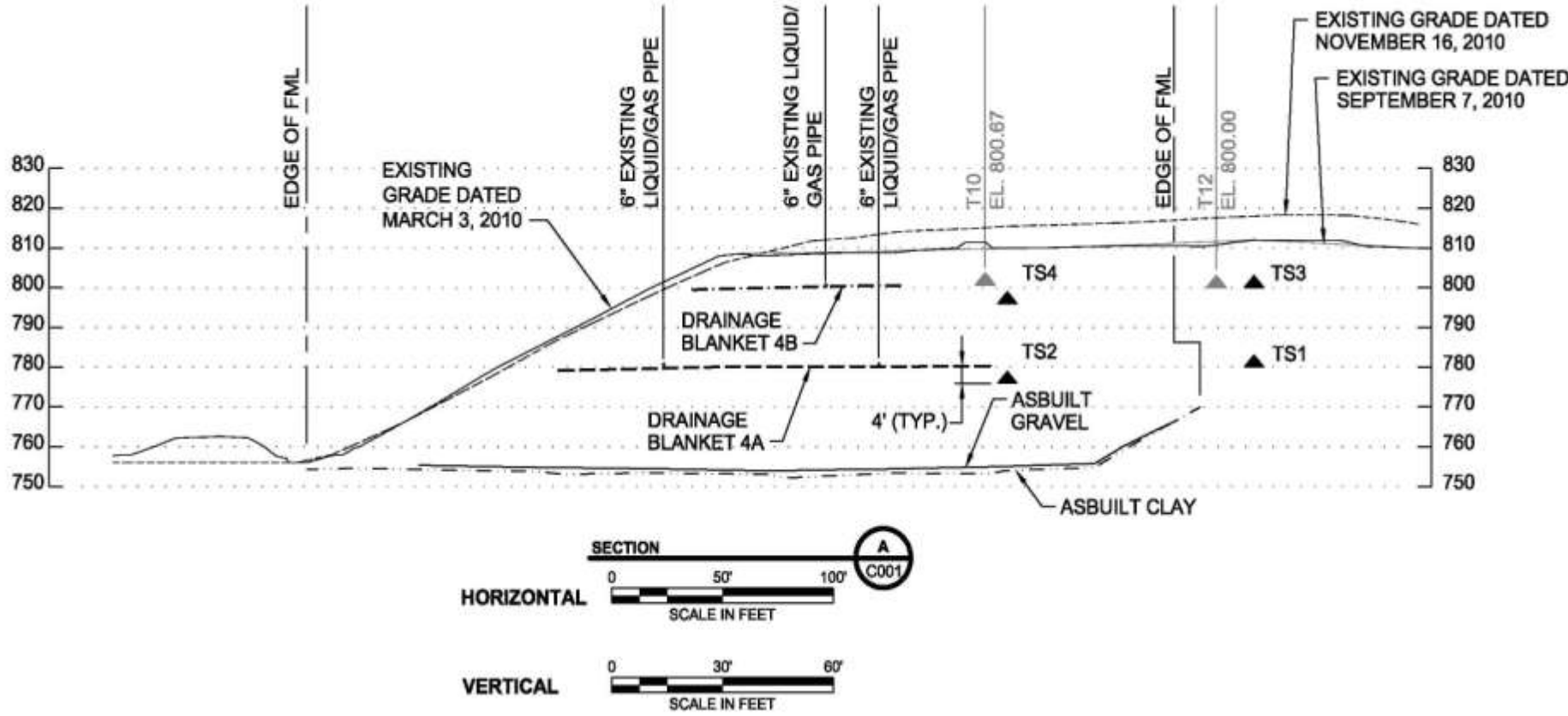
- Installed w/ Drill Rig
- Electrical Conduits
- Compliance and Blanket Performance





PRE-SUBTITLE D
DISPOSAL AREA
SEE NOTE 1
GR-33
MH-4
747.3
749.0
749.6
748.5
MH-5
C4-1
C4-2
C4-3
C4-4
C4-5
750
HGL - 820A
HGL - 820B
T7
EL. 780.28
TS1
TS3
T4
EL. 779.46
T1
EL. 779.83
T12
EL. 800.00
CELL 4 BOUNDARY
T13
EL. 800.80
T8
TS5
TS9
TS7
TS2
TS4
830
T9
(NO ASBUILT LO
AVAILABLE)
T10
EL. 800.67
T5
EL. 779.80
ASBUILT DRAINAGE
BLANKET 4A
T6
T11
EL. 800.32
T3
(NO ASBUILT
LOCATION
AVAILABLE)
TS8
TS10
T2
EL. 779.91
TS6
EXISTING 4A
WELL HEAD
820
CELL 4
(ACTIVE)
810
CONDUIT TRENCH (TYP.) BACKFILL
TRENCH WITH SELECT SOIL FOR
AT LEAST 30' AS TRENCH
APPROCHES TOP OF SLOPE
800
EXISTING 6" PERFORATED
LIQUID/GAS PIPE
790
ASBUILT DRAINAGE
BLANKET 4B
780
770
CELL 4 BOUNDARY
770

Sensor Locations



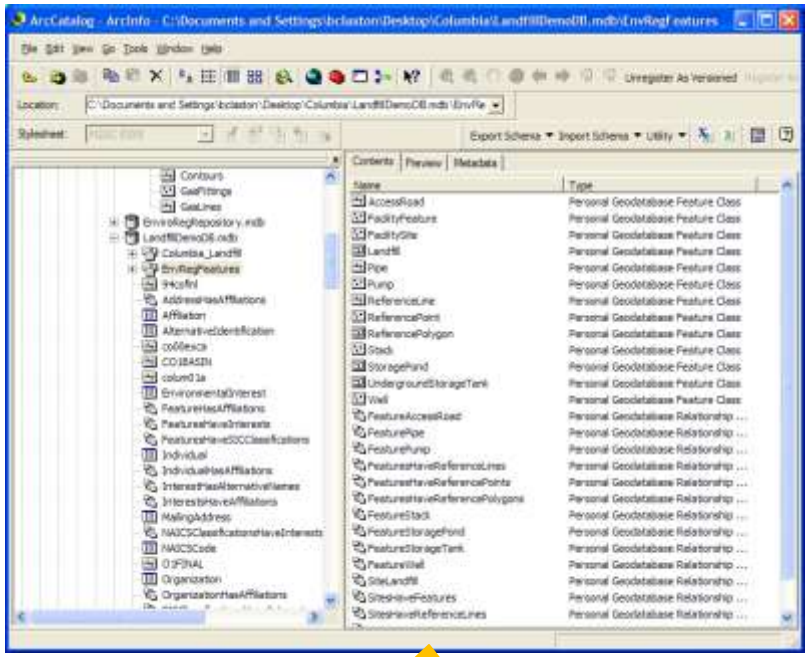
Other Activities/Projects

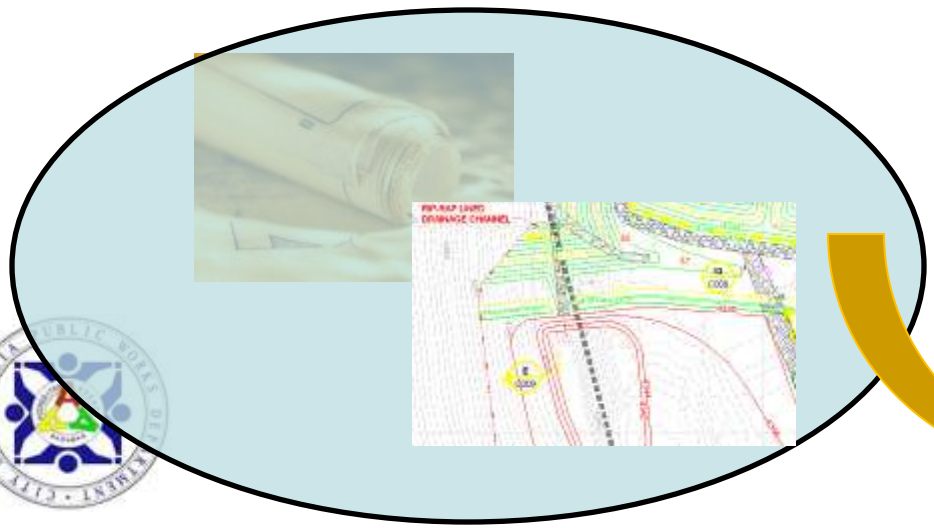
- Phytoremediation Project
- GIS Database
- Cell 5/East Lake Dam Construction
- Landfill Gas Management

Voluntary Phytoremediation Project

Columbia GIS System

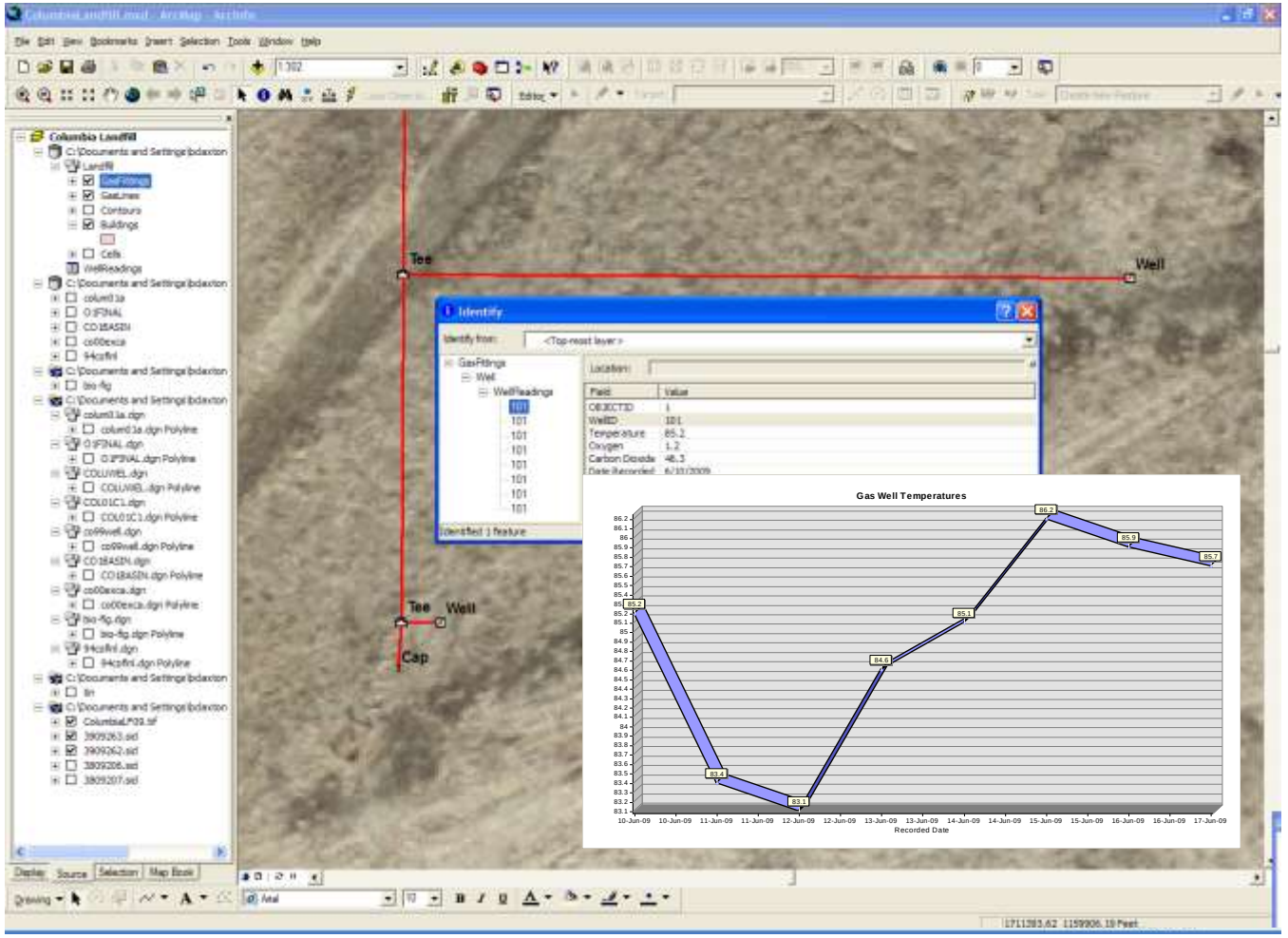
- Develop GIS Database
  - Landfill Features
  - Data About Each Feature
- Convert Existing Data
  - Paper & Digital





GIS

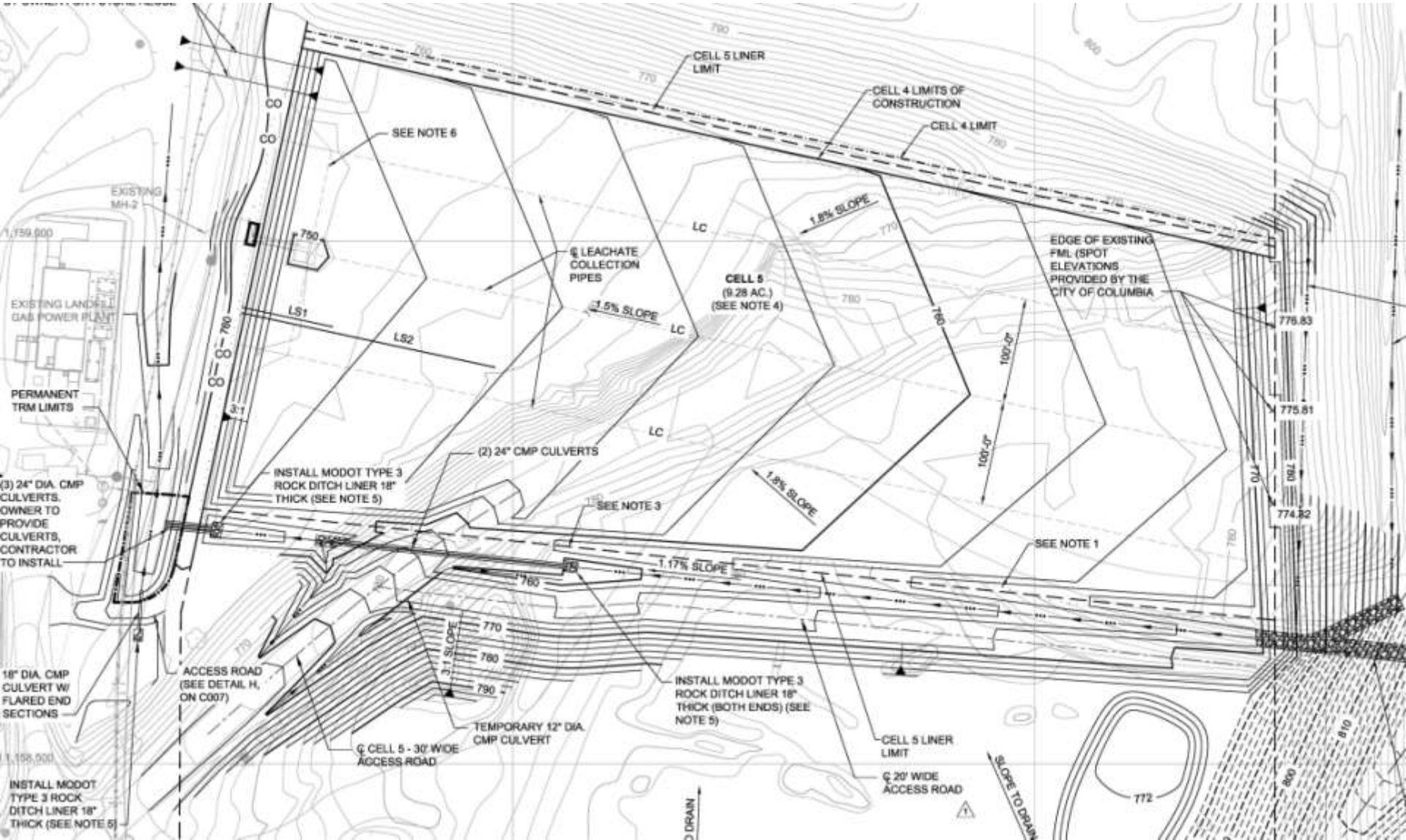
- GIS Database Usage



Cell 5/East Lake Dam

- $2.3 Million,9.28 Acre Cell 5 Bioreactor Construction in April
  - Includes $221,977 east lake dam construction
    - Access to liner material which doubles as dam for increased water source for bioreactor

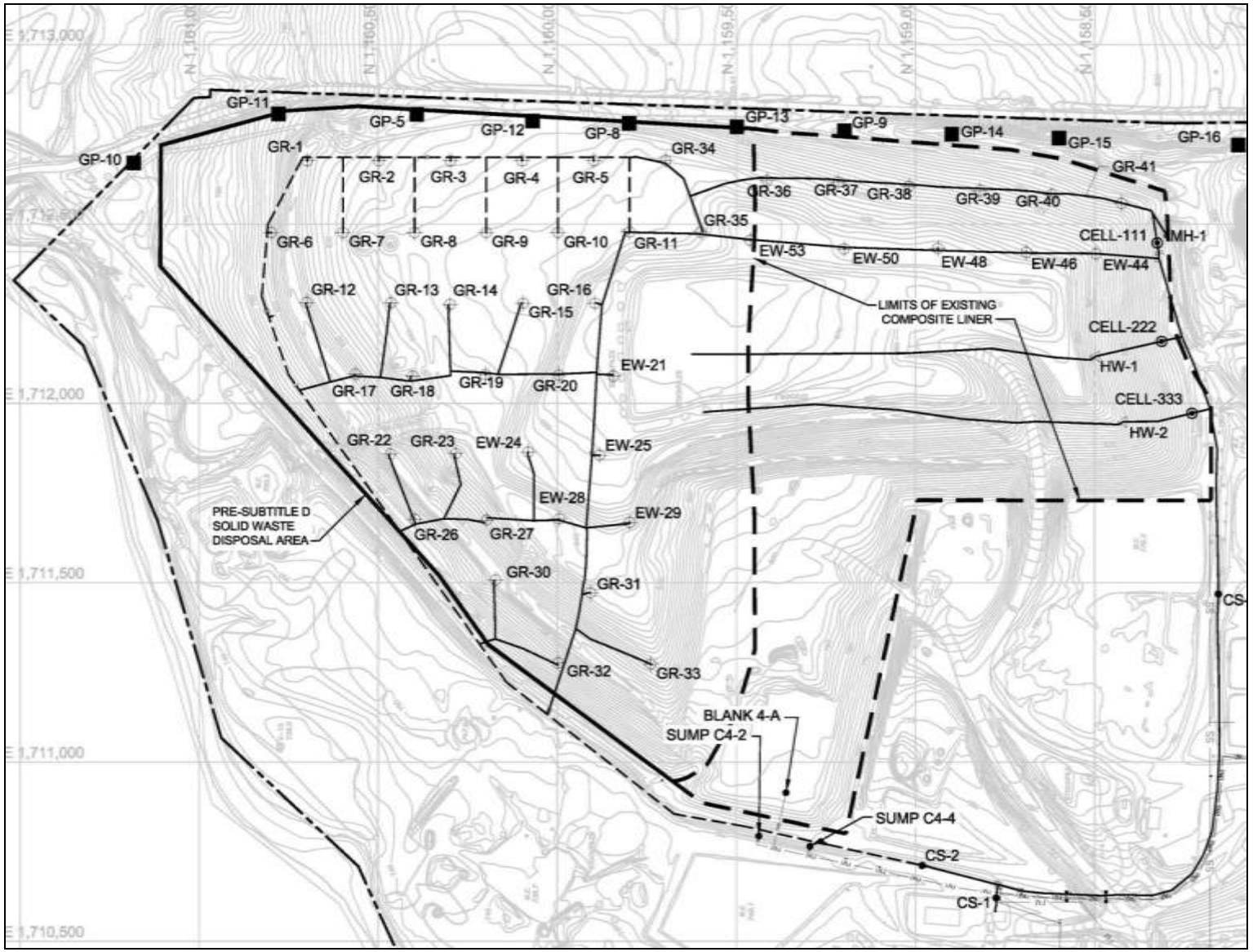
Cell 5 Construction 2011



Gas Recovery System

- 47 Gas recovery wells
- 850 Cubic feet of landfill gas extracted per minute
- Averaging 47-48 percent methane
- Cubic foot of methane contains 950 MMBTU

LFG System


GP-11
GP-5
GP-12
GP-8
GP-13
GP-9
GP-14
GP-15
GP-16
GP-10
GR-1
GR-34
GR-41
GR-2
GR-3
GR-4
GR-5
GR-36
GR-37
GR-38
GR-39
GR-40
GR-35
GR-6
GR-7
GR-8
GR-9
GR-10
GR-11
CELL-111
MH-1
EW-53
EW-50
EW-48
EW-46
EW-44
GR-12
GR-13
GR-14
GR-16
GR-15
LIMITS OF EXISTING COMPOSITE LINER
CELL-222
HW-1
EW-21
GR-17
GR-18
GR-19
GR-20
CELL-333
HW-2
GR-22
GR-23
EW-24
EW-25
EW-28
EW-29
PRE-SUBTITLE D SOLID WASTE DISPOSAL AREA
GR-26
GR-27
GR-30
GR-31
CS-
GR-32
GR-33
BLANK 4-A
SUMP C4-2
SUMP C4-4
CS-2
CS-1

Landfill Gas to Energy Project

Electrical Generation

- $2.8 million LFGTE plant
- Plant came online June 16, 2008
- Generating 2.1 Megawatts
- Public Works and Water & Light agreement for $11.38/mWh FY10=$148,531

LFG Migration Challenges

Lessons Learned –

Historically non-sensitive system now sensitive

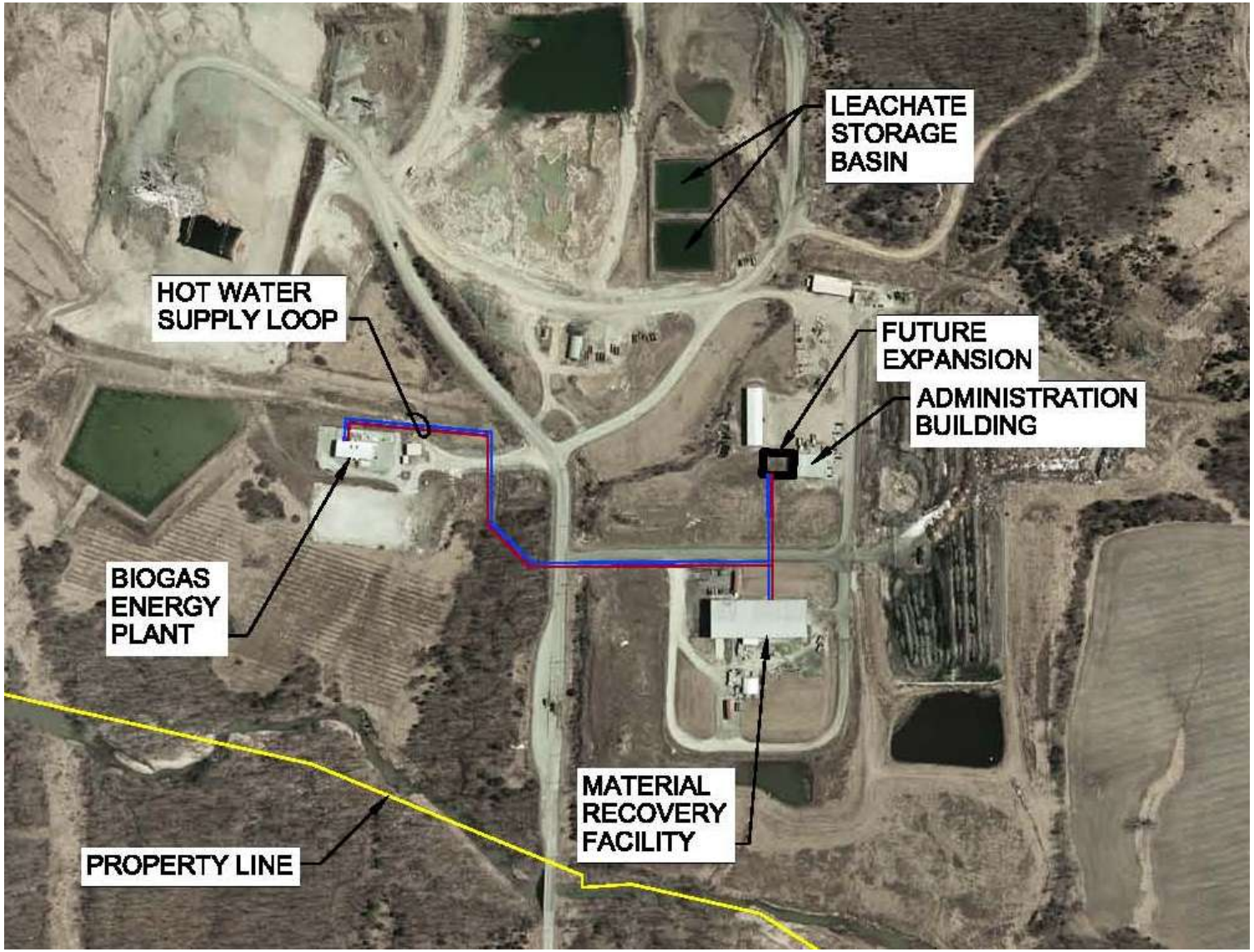
- Very sensitive to LFGTE down time
- Seemingly more sensitive to weather

KEY: Well field balancing and continual communication with Bioplant staff

Recent ARRA Grant Award

- Won $1,000,000 Energize Missouri Communities Grant Award
- Funding Applied:
  - Replace Biogas Generator at WWTP
  - Combined Heat & Power (CHP) System at Landfill
- Cost to Prepare Grant App. ~$15,000

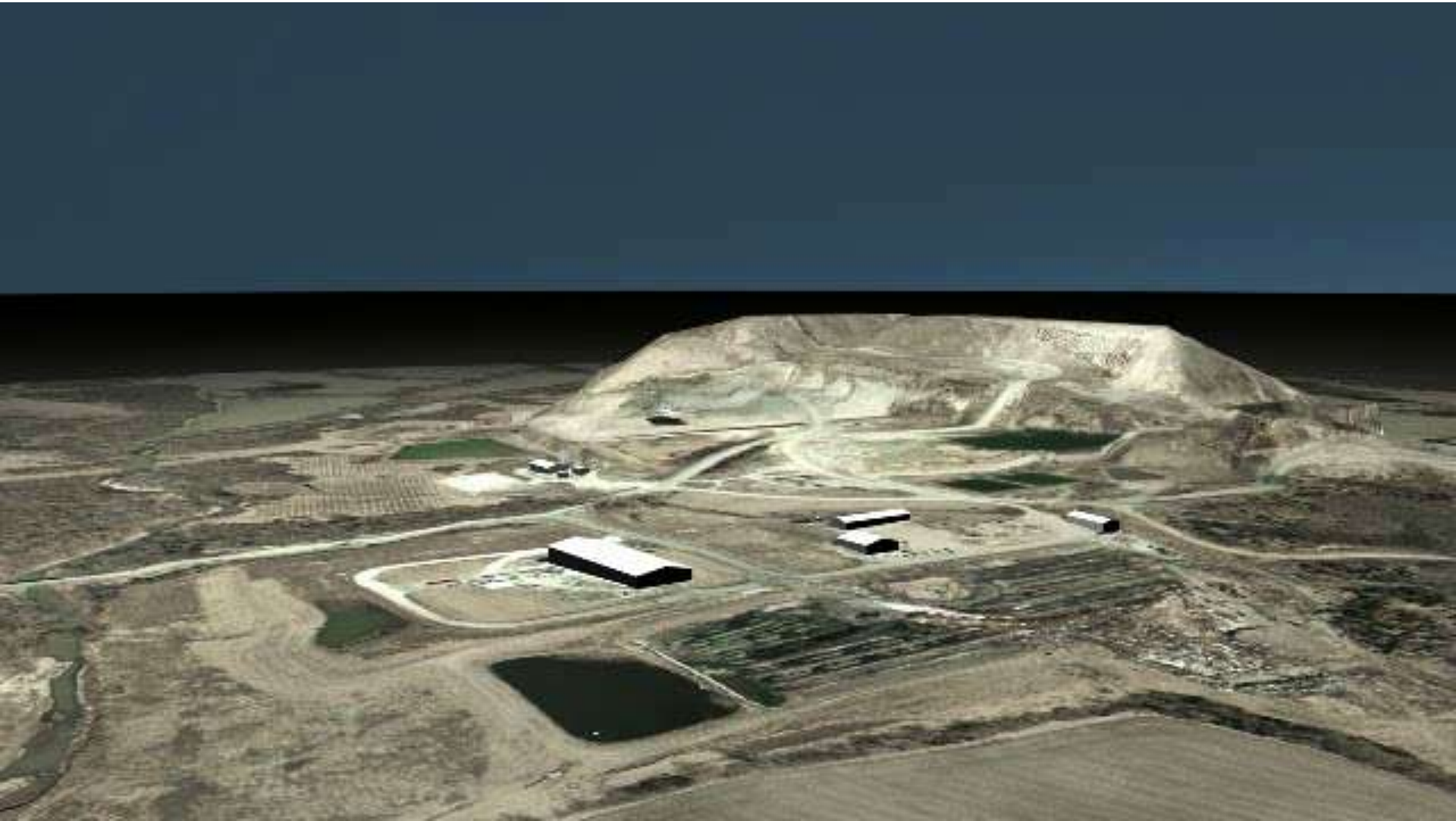
CHP System


LEACHATE STORAGE BASIN
HOT WATER SUPPLY LOOP
FUTURE EXPANSION
ADMINISTRATION BUILDING
BIOGAS ENERGY PLANT
MATERIAL RECOVERY FACILITY
PROPERTY LINE

CHP System Details

- Initial Heat Recovered: 677,400 MMBtu/hr (one engine)
- Equivalent to heating about 24 Residential Homes
- GHG emissions reduced
- Initial Heating cost savings $12,515/yr
- Infrastructure Now for Double Capacity

Bioreactor Simulation



Why Bioreactor ?

- Environmental & Economic Benefits
  - Waste Stabilization - Extend the life expectancy of the landfill by 5 years
  - Accelerated Gas Generation
  - Estimated savings over the life of landfill between $5 and $8 million

Lesson Learned

- Non-compacted trash is hard to drive on
- Mulch helps control odor
- Extra piping limits access
- Blanket and Working Face Conflicts
- Gas migration and electrical generation draws on gas field are different
- Start record keeping

QUESTIONS?

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